DETERMINING THE SIZE OF EASTERN FOREST RESERVES

The challenge of conserving eastern forests

Forest conservation: a collaborative effort

The legions of people working to protect the forests of eastern North America bring to this task their cultural values, science, and passion. A new harmony is emerging between landowners, land trusts, advocates, and government agencies as it becomes increasingly clear that complementary strategies are needed to protect our forests. We need to protect more and bigger reserves; to buffer them with better managed forests of sufficient size to provide secure habitat; to address economic needs; and to mitigate other assaults on our forests. This booklet summarizes a scientific approach to forest protection, and provides a glimpse of the successes that creative partnerships have already achieved.

Why we need forest reserves

Because of the relentless deforestation following European settlement, today's forests are typically young or middle-aged and lack important stabilizing features such as large, decaying trunks on the forest floor and big, standing snags. Few remnants remain of mature forests with old trees, understories, and soils shaped by a history of natural disturbances—such as fires, hurricanes, and tornadoes—that guarantee increased structural diversity and habitat important to many species. Timberland, where disturbance is accompanied by extraction, is not ecologically equivalent to mature forests. Forest reserves can retain or restore the features of original forests, including their species and soils.

In addition to logging, fragmenting features such as roads, power lines, developments, and ski areas now crisscross eastern forests. Broad, regional threats—including climate change, atmospheric pollutants, and non-native pests—also add significantly to the challenges undertaken by the conservation community.

It might be possible to conserve the 165 native tree species in our region with careful forest harvesting. However, to restore complex forest ecosystems will require the founding of additional forest reserves and careful stewardship of both reserves and harvested lands. In this way, we can preserve the richness and abundance of millions of species.

Our cover photo of The Nature Conservancy's Vickie Bunnell Preserve in New Hampshire shows a nurse log, an example of the accumulating organic materials—collectively termed biological legacies—that link a system historically to a place, stabilize the ecosystem, and ultimately form new soil. Legacies include coarse woody debris, large snags, seed banks, and extensive fungal networks.

What is a forest ecosystem?

Forests are more than trees. They include a complex web of interacting species in the canopy and soil. Each of these organisms may perform critical functions central to the viability of the whole; some of these functions we are only now beginning to understand.

Forests provide habitat for animals–called forest interior species–that need or thrive under conditions found in the deep forest. These include creatures such as the pine marten, spruce grouse, and many warblers. Other species–like bobcat, fisher, and moose–depend on forests for part of their life cycle. Set within the forest are smaller ecosystems offering a wide range of habitat, such as barrens, bogs, marshes, rivershore grasslands, and streams. These ecosystems depend on the condition of the surrounding forested landscape for their long-term persistence and health.

How big should a forest reserve be?


ice storms


hurricanes


downbursts


tornadoes


conifer forest fires

deciduous forest fires

Big enough to withstand catastrophic events

A 10,000 ACRE RESERVE

4X SIZE OF SEVERE DAMAGE PATCH

A 28,000 ACRE RESERVE

A forest reserve is likely to accommodate all the natural disturbances and species to the left of its size indicator.

acres 5,000 10,000 15,000 20,000 25,000 30,000 35,000 40,000

Big enough to support breeding territories

25X FEMALE BREEDING TERRITORY SIZE

Reserves can't stand alone

See the back panel for information about areas that help protect species needing more space than the reserve offers.


small creatures and plants

northern flying squirrel
wood turtle
mole salamander
small invertebrates
mosses/lichens


saw-whet owl

sharp-shinned hawk

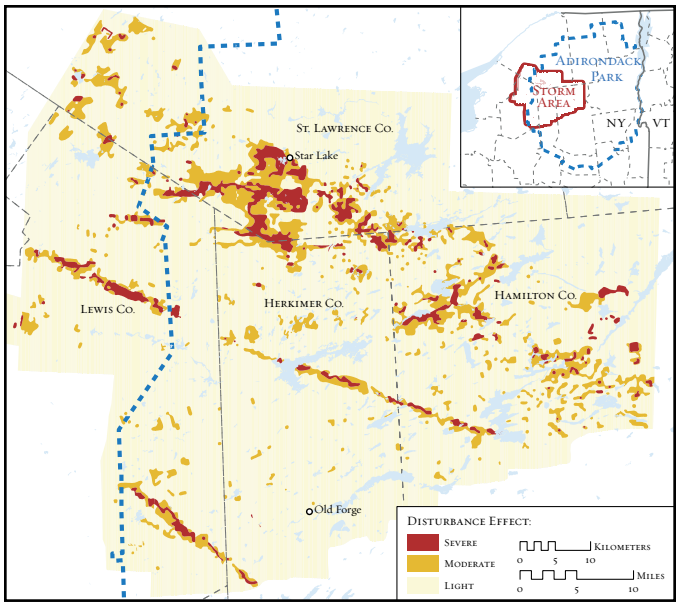
area sensitive songbirds


northern goshawk

broad-winged hawk


barred owl


pine marten



Impact of Adirondack storm of July 15, 1995

Adirondack storm data from NY State Department of Environmental Conservation.

Big enough to withstand catastrophic events

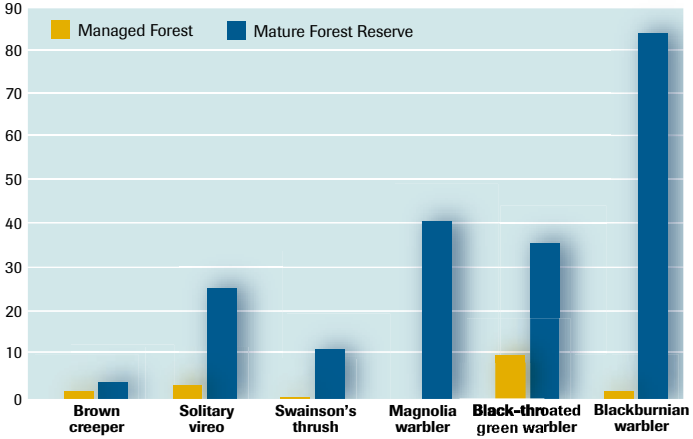
Eastern forests are subject to hurricanes, tornadoes, fires, ice storms, downbursts, and outbreaks of insects or disease. While most of these disturbances are small and recovery is fast, damage from larger catastrophic events may last for decades. Resilient forest ecosystems can absorb, buffer, and recover from the full range of natural disturbances.

The effects of catastrophic natural events are typically spread across a landscape in an uneven way. Patches of severe damage are embedded in larger areas of moderate or light disturbance. Using historical records, vegetation studies, air photo analysis, and expert interviews, Nature Conservancy scientists determined the size and extent of patches of severe damage for each disturbance type expected over one century. Historic patterns in New England suggest that an area of about four times the size of the largest severe damage patch is necessary for a particular forest reserve to remain adequately resilient.

Big enough to support breeding territories

Forest ecosystems must also be big enough to support characteristic interior species. Many species establish and defend territories during breeding season, from which they obtain resources to raise their young. Twenty-five times the average size of a territory, together with information on other minimum area restrictions for that species, may be used as an estimate of the space needed for a small population. This reflects a rule of thumb developed for zoo populations on the number of breeding individuals required to conserve genetic diversity over generations.

Average Number of Breeding Bird Pairs per 99 Acres



Mature forests retain a history of naturally occurring disturbances that foster increased diversity. This research found that the average number of certain forest bird breeding pairs is much greater in a mature forest reserve than in a managed forest.

Adapted from Haney, J.C., and C.P. Schaadt. 1996. Functional role of eastern old-growth in promoting forest bird diversity. In M.B. Davis (ed.) *Eastern old-growth forests: prospects for rediscovery and recovery.* Island Press. Washington DC.

Ecoregions of the northeast

J. Keys, Jr. et al. 1995. Ecological Units of the Eastern United States: first approximation. Atlanta, GA: U.S. Department of Agriculture, Forest Service.

Combining the size factors

The Nature Conservancy has applied the territory size and disturbance factors to all the ecoregions of the northeast, and tailored minimum size thresholds for forest reserves to each ecoregion's forested extent, ecology, and natural disturbance history. So, for example, while the resulting size threshold in the U.S. Northern Appalachians is 25,000 acres, in the Central Appalachians and Lower New England ecoregion it is 15,000 acres, and in the St. Lawrence-Champlain Valley and Chesapeake Bay Lowlands it is 10,000 acres. These values serve as guidelines for conservation planners working in particular forest areas, where the landscape context will dictate adjustments to the recommended size.

The optimal forest reserve contains enough space to accommodate the smallest forest interior species and the largest landscape disturbances.

Making progress

Federal GAP status definitions

GAP 1: Permanent protection for biodiversity. Examples: nature reserves; research natural areas; wilderness areas; Forever Wild easements.

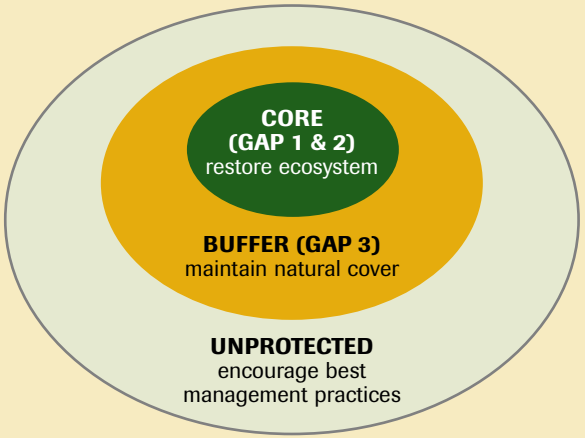
GAP 2: Permanent protection to maintain a primarily natural state. Examples: National Wildlife Refuges; many state parks; high use National Parks.

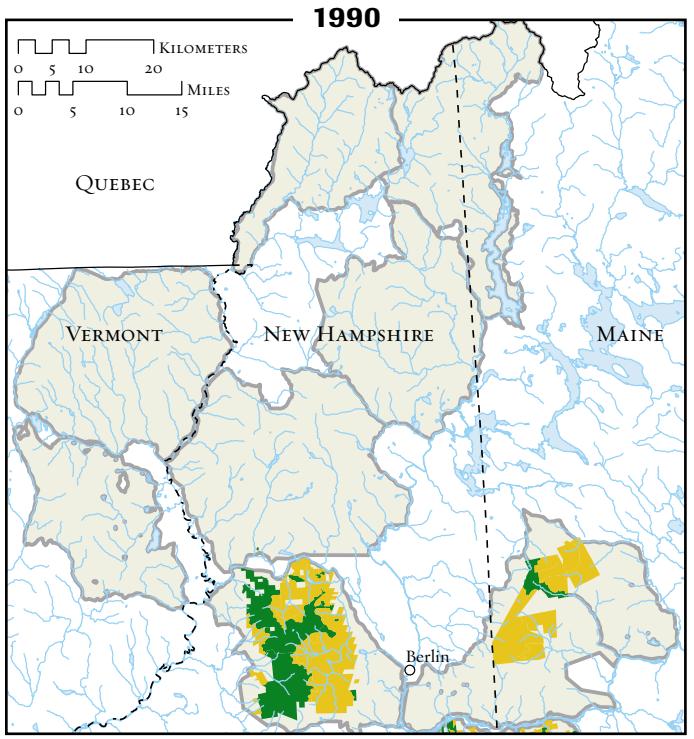
GAP 3: Buffer lands, protected as natural cover but typically subject to extractive uses such as logging. Examples: State or Town forest or Crown lands in Canada managed for timber; land protected from development by forest easements.

The core-buffer model

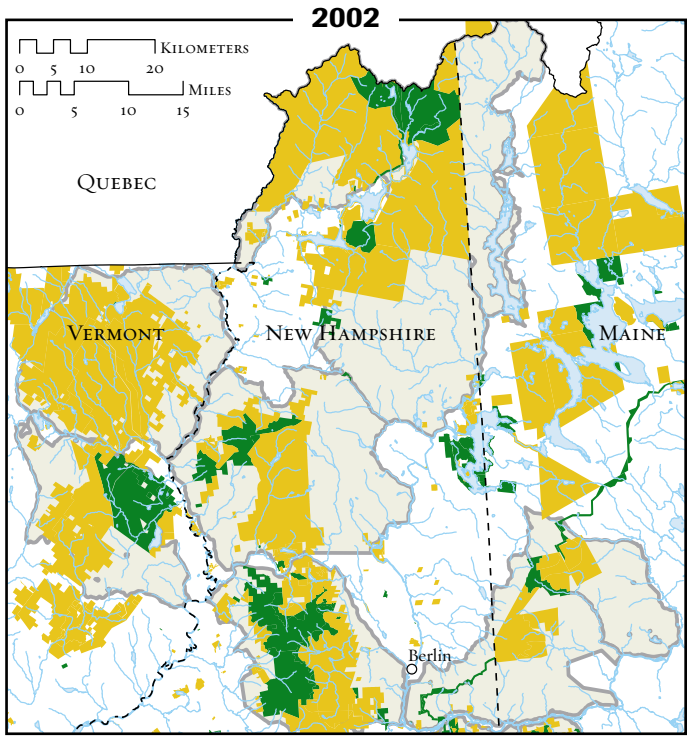
The core-buffer model below shows core areas of high protection (GAP 1 and 2) surrounded by forests protected from conversion, such as by forest easements (GAP 3). These areas in turn may be embedded in unprotected forest land. Forest certification can help ameliorate effects of harvesting, although certification has no guarantee of permanency.

Buffering the core with surrounding forests maintains some landscape-scale processes and gives better results than strict wildlife corridors in sustaining animal movements. The locations of smaller ecosystems, rare species, and high quality forest can be used to determine the optimal placement of a core reserve within a larger forest area.





Critical forest areas identified by The Nature Conservancy and others (outlined in gray) were mostly unprotected in 1990.



By 2002, many critical forest areas had a core reserve and buffer.

Increasing protection in the U.S. portion of the Northern Appalachians

Collaborating with others throughout the region, Nature Conservancy scientists identified priority areas for forest conservation. The Conservancy's goal is to establish a large core and buffer area in each.

To track progress toward this goal, scientists and conservationists regionwide categorize thousands of individual parcels of existing and new managed area into one of three protection levels using a system developed by the U.S. federal Gap Analysis Program. The maps above highlight the accomplishments of over a decade of collective protection efforts.

Across the U.S. Northern Appalachians, twenty-seven critical forest areas have core reserves of over 25,000 acres. Less than one million additional acres of strategically placed land protection are all that is needed to complete a system of over 70 core forest reserves in this ecoregion.

Federal GAP status definitions modified from Scott, J.M. et al. 1993. Gap analysis: A geographic approach to protection of biological diversity. *Wildlife Monographs* 123.

Core-buffer model adapted from Noss, R.F. 1987. Protecting natural areas in fragmented landscapes. *Natural Areas Journal* 7: 2-13

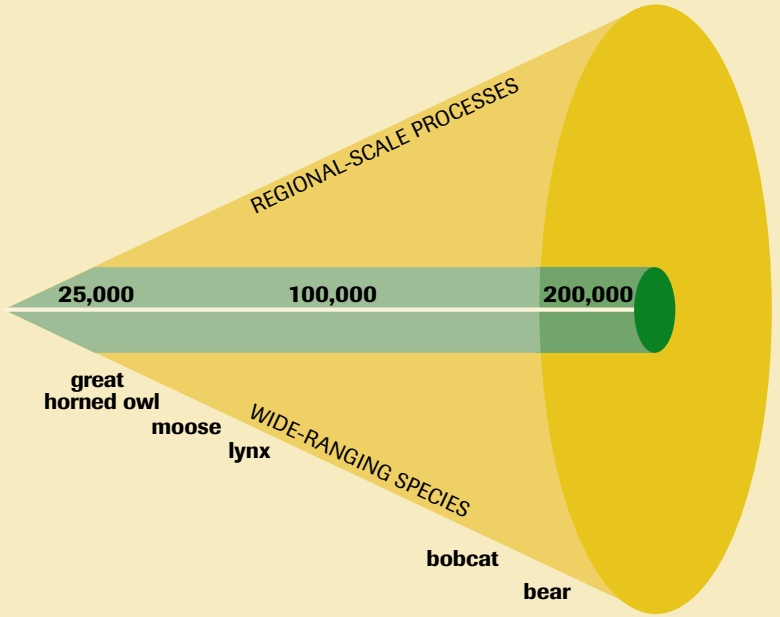
All forest land data for the ecoregions of the northeast cited in this publication is current as of November 2003.

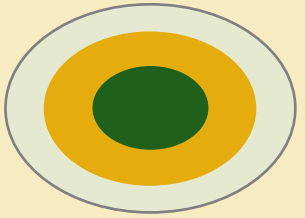
Core reserves can't stand alone

The disturbances and wide-ranging species shown in this model operate at increasingly large scales. In order to accommodate these larger processes and protect wide-ranging species, each core forest reserve should be buffered by an equally-sized or larger area of protected lands that maintain forest cover while permitting broader uses.

Who is conserving the eastern forest?

Multiple organizations often work within the same site to collectively protect larger parcels of land. In Maine's Greater Baxter forest, more than 270 organizations own conservation land. New Hampshire's Andorra forest lies in the Lower New England-Northern Piedmont ecoregion, where the number of partners for any given site may be even greater.





Greater Baxter Forest

CORE

- Baxter State Park
- The Nature Conservancy
- Appalachian Trail Conference

BUFFER

- Katahdin Paper
- Baxter Science Forest Management Area
- Maine Department of Conservation
- Private landowners
- Gardner Land Company
- International Paper

UNPROTECTED

Andorra Forest

CORE

- Society for the Protection of NH Forests
- The Nature Conservancy
- Private land under Forever Wild easements
- Sweet Water Trust
- Wildlife sanctuaries
- Audubon Society of New Hampshire
- Harris Center for Wildlife Education

BUFFER

- Society for the Protection of NH Forests
- New England Forestry Foundation
- New Hampshire Dept of Resources and Economic Development
- Private land under non-development easements
- Town forests

UNPROTECTED

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

Eastern U.S. Conservation Region
Conservation Science Program
11 Avenue de Lafayette, 5th Floor
Boston, MA 02111 • nature.org

The mission of The Nature Conservancy is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. The Conservancy protects about one quarter-million acres of reserves and over 270,000 acres of easements in New England and New York. Dr. Mark Anderson directs the ecological assessments described in this booklet.

Sweet Water Trust
Faneuil Hall Marketplace
4 South Market Building, 4th floor
Boston, MA 02109 • sweetwatertrust.org

Sweet Water Trust is dedicated to the preservation of wild nature, funding conservation projects that safeguard wild lands, wild waters, native wildlife, and living soils in the Northern Appalachian region. Since 1991, we have helped conservation groups protect over 200,000 acres in the region. We currently hold over 45,000 acres of fee and easement lands (mostly GAP 1) in five preserves in four states.

Text and concept: Mark Anderson, with Susan Bernstein and Frank Lowenstein of The Nature Conservancy, and Nancy Smith and Sigrid Pickering of Sweet Water Trust.

Data: U.S. Natural Heritage programs, Canadian Conservation Data Centres, and Nature Conservancy Canada contributed important data to the ecological assessments.

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Design: *tabula rasa* graphic design

Photography: *Cover/page one:* Vickie Bunnell Preserve, Daryl Burtnett; Black and white warbler, Rob Kipp. *Center panel:* Lichen, Libby Collins; Saw-whet owl, Mary Droege/TNC; Northern goshawk, Tom and Pat Leeson; Barred owl, Eric Dresser; Pine marten, The Wilderness Classroom. *Page 3:* Wilson's warbler, Rob Kipp; Polygonia butterfly, Erik Nielsen; Big Reed Reserve, Bill Silliker, Jr. *Back cover*: Moose in Baxter State Park, Ross Geredien

Disturbance and species data for the Northern Appalachian-Acadian ecoregion: Disturbance sizes from Anderson, M.G. 1999. *Viability and Spatial Assessment of Ecological Communities in the Northern Appalachian Ecoregion.* University of New Hampshire, Durham, NH. Ph.D. dissertation.

Species territories based on DeGraaf, R.M. and M. Yamasaki. 2000. *New England Wildlife: Habitat, Natural History and Distribution.* New England Press.

Birds of North America, No. 1-600 (Poole, A., P. Stettenheim, and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologist's Union.

Average for area-sensitive songbirds taken collectively, based on Robbins, C.S., D.K. Dawson, and B.A. Dowell. 1989. Habitat area requirements of breeding forest birds of the Middle Atlantic states. *Wildlife Monographs* 103: 1-34.

For more information on the ecological approaches to conservation described here, go to www.sweetwatertrust.org/forestreserves

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